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Assessing phytoplankton communities in the Sacramento and San Joaquin Rivers using microscopic and indirect analytical approaches

Abstract: Long-term monitoring data of phytoplankton community species composition exist for the San Francisco Estuary-Delta (SFE). These data are based on conventional microscopy techniques. In recent years, these efforts have been augmented with new technologies (e.g. spectrofluorometry and flow cytometry) to indirectly monitor phytoplankton communities over broader temporal and spatial scales. River surveys in the Sacramento and San Joaquin Rivers were carried out in spring 2010 to characterize phytoplankton community structure and environmental parameters upstream and downstream of the Sacramento Regional and Stockton Waste Water Treatment Plants. Phytoplankton community composition was assessed using four methods; conventional light microscopy, measurements of size-fractionated chlorophyll-*a* concentrations, flow cytometry and spectrofluorometry (bbe FluoroProbe). From these observations we tested the hypothesis that for use in routine monitoring programs, a combination of indirect approaches may be sufficient to characterize riverine phytoplankton communities. The trends that emerged using the indirect approaches were consistent between the two river environments, with higher overall phytoplankton biomass in the San Joaquin River and a majority of large cells, dominated by the "brown" FluoroProbe group. In contrast, the Sacramento River phytoplankton biomass was less, the majority of cells were small, and the phytoplankton community was dominated by the "green" FluoroProbe group, containing chlorophytes. These indirect approaches compared well with the direct microscope counts and size fractionated chlorophyll-*a* in that the San Joaquin River was dominated by centric diatoms (*Cyclotella and Melosira*), which fall in the "brown" group, while the Sacramento River had a high proportion of small flagellates, including chlorophytes. While none of the indirect methods used provide the detailed picture of phytoplankton community structure that can be obtained from microscopy, functional groups appear to be reasonably elucidated using a combination of these approaches.

Statement of Relevance: The long term decline of phytoplankton biomass in the SFE-Delta has been proposed as a cause of the Pelagic Organism Decline. This research assessed several approaches for monitoring the phytoplankton community to inform research and policy decisions related to management of the Delta.